



## Original Research Article

# Perceptions and attitudes toward digital dentistry among dental professionals: a questionnaire survey study

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## ABSTRACT

**Introduction:** In recent decades, digital technologies have become increasingly essential in dentistry, continuing the field's long-standing necessity of cutting-edge technology and innovation.

**Aims and Objectives:** The objective of the study was to determine the perception and attitude of dentists towards the use of digital technology.

**Materials and Methods:** A Questionnaire study was conducted amongst 400 dental professionals. The questionnaire was sent electronically to all participants. The data from the filled forms was then compiled in a spreadsheet. The data was analyzed using IBM-SPSS (Statistical Package for Social Studies) Version 22. P value was taken as statistically significant (P-Value < 0.05).

**Results:** 58% dental professionals did not receive any training. 42% dental professionals have received formal training or education in digital dentistry during their professional career while 58% didn't receive any training. 62% of professionals have noted changes in treatment outcomes or patient satisfaction since integrating digital dentistry technologies into their practice. 77% of participants expressed a willingness to adopt CAD/CAM systems in their practices. More than 75% were optimistic about bright future of digital technologies in dentistry in improving patient care and treatment outcomes.

**Conclusion:** The majority of dental professionals were in the favor of incorporation of digital dentistry into clinical practice. Initial high cost of equipment's and lack of formal training were the major barrier for incorporating digital technologies in routine clinical practice.

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## 1. Introduction

Cutting-edge technology and innovation have long been associated with dentistry.<sup>1</sup> Over the last few decades, as dental technology has progressed, digital technologies have increasingly gained importance.<sup>2</sup> Communication and information handling in dental practices are more computer-mediated now than before. Additionally, digital imaging and photography are increasingly common in diagnosing, and digital methods are being utilized more for processes such as impression taking, treatment planning, and implant

surgery.<sup>2</sup>

Technological advancements are transforming all areas of life, including dentistry. The digitization of medical information, 3D modeling, and even artificial intelligence are just a few examples of the major technical advancements that have revolutionized the dental industry.<sup>3</sup> Modern medical care and treatment are undergoing a revolution due to digital technology. Dentistry must enhance its understanding of how digital workflow models and digital health information are revolutionizing and disrupting dental practice. This understanding is crucial for anticipating how this digital transition will impact dentistry.<sup>4</sup> Digital

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dentistry offers numerous benefits, including increased patient happiness, improved workflow, higher-quality records, and accurate diagnosis. Other advantages include better doctor-patient communication, lower overhead costs, reduced chairside time, minimized exposure to radiation, and shorter appointment times, all of which contribute to enhancing the quality of care.<sup>5</sup> Clinical change in healthcare is examined through a variety of obstacles and motivations, including costs, lack of comfort and familiarity with technology, and financial considerations.<sup>2</sup> According to a study conducted in the Thames Valley Strategic Health Authority region, 241 dentists (77%) were capable of handling digital technologies, but only a few of them were sufficiently competent to utilize these gadgets effectively.<sup>6</sup>

There is a lack of literature regarding dental professionals' knowledge and perception of digital dentistry. Given the increasing interest in technology mainly driven by industry, it is essential to explore whether dental professionals' knowledge and expectations of digital dentistry are current with the continually updated dental curriculum. This questionnaire-based survey primarily aimed to measure the level of perception, awareness, and attitude toward digital dentistry in dental professionals.

## 2. Materials and Methods

### 2.1. Study design

This is a cross-sectional study conducted among the dental professionals in Maharashtra state using an online survey.

### 2.2. Study sample

400 dental professionals in Maharashtra state were utilized in this study.

### 2.3. Study instrument

An online questionnaire was constructed comprising questions related to demographic data, followed by inquiries concerning knowledge and perceptions toward the use of digital dentistry among dental professionals.

## 3. Instrument Validity and Reliability

We conducted a pilot study by distributing the survey to 20 participants and inputting the data into SPSS version 22 to calculate Cronbach's coefficient alpha (value 0.648).

The validity of the questionnaire was assessed by sending it to experienced researchers at MUHS, and adjustments were made based on their feedback and comments.

### 3.1. Statistical analysis

Collected data were analyzed using SPSS version 22, where descriptive as well as inferential statistics were conducted.

Comparisons between groups were made with the value of significance kept under 0.05 using the Chi-square test

### 3.2. Questionnaire that was asked to dental professionals-

How would you rate your familiarity with digital dentistry technologies, such as CAD/CAM systems, intraoral scanners, and 3D printing?

1. Very familiar
2. Somewhat familiar
3. Not very familiar
4. Not familiar at all

Have you received formal training or education in digital dentistry during your professional career?

5. Yes
6. No

Your opinion, what are the primary benefits of integrating digital dentistry technologies into dental practice? (Select all that apply)

1. Improved accuracy of restorations
2. Time savings in treatment planning and fabrication
3. Enhanced patient communication and education
4. Greater efficiency in workflow
5. Expanded treatment options
6. Others

What do you perceive as the main challenges or barriers to adopting digital dentistry technologies in your practice? (Select all that apply)

High initial cost of equipment  
Lack of adequate training or support  
Concerns about the reliability or accuracy of digital systems

Resistance to change among staff or colleagues  
Limited reimbursement from insurance providers

### 3.3. Others

Have you observed any differences in treatment outcomes or patient satisfaction since incorporating digital dentistry technologies into your practice?

1. Yes
2. No
3. Not applicable (I have not integrated digital dentistry technologies into my practice)

What additional resources or support would you need to facilitate the adoption of digital dentistry technologies in your practice?

1. Financial support

2. Training
3. Feasibility
4. Awareness
5. Essential training for handling technologies and necessary precautions

How likely are you to invest in digital dentistry equipment or software for your practice within the next two years?

- Very likely
- Somewhat likely
- Unsure
- Not very likely
- Not likely at all

How do you perceive the future role of digital dentistry in the field of prosthodontics and restorative dentistry?

1. It will be the future of dentistry
2. Great accuracy, time saving and good prognosis
3. Minimal invasive techniques
4. positive patient feedback

What factors would influence your decision to recommend digital dentistry treatments to your patients? (Select all that apply)

1. Clinical evidence supporting the efficacy of digital techniques
2. Patient preference for digital workflows
3. Availability of advanced training opportunities
4. Reimbursement policies from insurance providers
5. Other (please specify)

How do you stay informed about advancements and updates in digital dentistry technologies? (Select all that apply)

1. Professional conferences and seminars
2. Continuing education courses
3. Industry publications and journals
4. Online forums and discussion groups
5. Manufacturer updates and trainings
6. Others

On a scale of 1 to 10, how optimistic are you about the future of digital dentistry in improving patient care and outcomes?

Any additional comments or insights you would like to share regarding digital dentistry in prosthodontics and restorative dentistry?

#### 4. Results

For each question, the number of responding clinicians was tabulated and converted into percentages. The results are presented in Figures 1, 2, 3, 4 and 5.

58 % dental professionals responded that they were somewhat familiar with digital dentistry technologies, such as CAD/CAM systems, intraoral scanners, and 3D printing while 31% were very familiar, 9% were not very familiar

and 2% were totally non familiar with digital technologies. 42% dental professionals have received formal training or education in digital dentistry during their professional career while 58% didn't receive any training. According to 84- 86% professionals, the primary benefits of integrating digital dentistry technologies into dental practice were improved accuracy of restorations and time savings in treatment planning and fabrication. 73-74% responded that digital technologies have enhanced patient communication, education as well as there is greater efficiency in workflow. 51% also thought there are expanded treatment options as well.

37% dental practitioner faces challenges or barriers to adopting digital technologies is high initial cost of equipments, 24% responded that they lack of adequate training or support and other 39% dental practitioner responded to Concerns about the reliability or accuracy of digital systems, Resistance to change among staff or colleagues and Limited reimbursement from insurance providers. 62% of professionals have noted changes in treatment outcomes or patient satisfaction since integrating digital dentistry technologies into their practice, while 32% have not observed any differences.

According to 61% of dentists, financial support is crucial for facilitating the adoption of digital dentistry technologies in their practice. Meanwhile, 39% of dentists believe that factors such as training, feasibility, awareness, and essential precautions for handling the technologies are key to successful adoption. 28% dental professionals likely to invest in digital dentistry equipment or software for their practice within the next two years, 49% were somewhat likely while 17% were unsure. 43% of professionals believe that digital dentistry will be the future of prosthodontics and restorative dentistry. Meanwhile, 28% of professionals highlighted the technology's accuracy, time-saving benefits, and positive prognosis. 17% noted positive patient feedback, while 12% pointed out its minimal invasiveness.

According to 36% of dental professionals, the availability of clinical evidence supporting the efficacy of digital techniques is a key factor in their decision to recommend digital dentistry. 26% of professionals consider the availability of advanced training opportunities important, while 24% cite patient preference for digital workflows. Additionally, 13% of dental professionals view reimbursement policies from insurance providers as a significant factor. 33% of professionals stay informed about advancements and updates in digital dentistry technologies through professional conferences and seminars. 23% rely on continuing education courses, while 18% use online forums and discussion groups. Additionally, 26% get their information from industry publications, journals, and manufacturer updates and training sessions.

On a scale of 1 to 10, regarding their optimism about the future of digital dentistry in improving patient care and

outcomes, 32% of dentists rated it a 10. 28% gave it a score of 8, while 18% assigned a score of 9. 12% of dentists rated it a 7, and 7% gave it a score of 6.

On a scale of 1 to 10, how optimistic are you about the future of digital dentistry in improving patient care and outcomes?

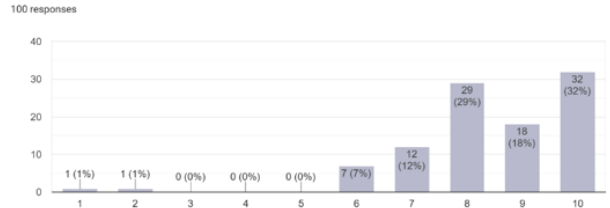


Figure 1: Diagrammatic representation of presentation of responses to Question 1, 2, 3.

Figure 5: Diagrammatic representation of presentation of responses to Question 11.



Figure 2: Diagrammatic representation of presentation of responses to Question 4, 5, 6.

manual and electronic. The manual method, which is paper-based, presents several challenges, particularly in converting data into an electronic format for processing and analysis. This process is often inefficient, costly, and time-consuming, and can result in incomplete or inadequate data.<sup>8</sup> Advancements in science and technology have streamlined electronic data collection, which can be accomplished through three primary methods: computer-administered surveys, electronic mail surveys, and web surveys.<sup>9</sup>

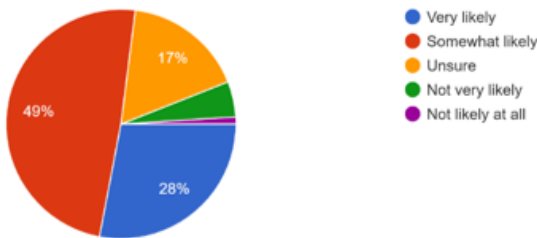


Figure 3: Diagrammatic representation of presentation of responses to Question 7.

In this study, a web-based survey was employed using Google Forms. This tool is ideal for distributing short questionnaires, charting results, and exporting data for spreadsheet analysis.<sup>7</sup> The use of Google Forms facilitates a larger sample size, reduces project costs, and shortens the data collection period. However, several factors may have contributed to a lower response rate, such as invalid email addresses, disinterest in participating, and the survey's limited relevance to some dentists. To enhance response rates, several strategies can be implemented, including offering incentives like prizes and lucky draws, sending reminders, and extending the survey period. Despite the lower response rate, adjustments were made to the level of significance to ensure that the results remained meaningful.



Figure 4: Diagrammatic representation of presentation of responses to Question 8, 9, 10.

Digital dentistry, particularly through CAD/CAM technology, has gained significant popularity over the past three decades. This technology has addressed many of the drawbacks associated with conventional methods, particularly in terms of quality, labor, and duration.<sup>10</sup> These advancements benefit both dentists and patients. A 2016 survey by Saponaro et al. on patient satisfaction with CAD/CAM fabricated complete dentures found that 70% of patients felt their new digital dentures were “better” than their previous ones.<sup>11</sup> As this field continues to evolve, it is crucial for dental practitioners to become practically knowledgeable about CAD/CAM technology, given that the future of dentistry is increasingly digital. The questionnaire-based survey conducted aimed to assess dental professionals’ perceptions, awareness, and attitudes toward digital dentistry. Out of the distributed questionnaires, 400 responses were received.

5. Discussion

Research fundamentally relies on data collection, with surveys being the most common method employed.<sup>7</sup> Data collection methods fall into two main categories:

Approximately 2% of the respondents were completely unaware of digital technology, while 58% were somewhat familiar. This indicates that many dental practitioners possess only a superficial understanding of the technology.

Despite the significant role of CAD/CAM technology in modern dental practice, there is limited information regarding current practices and attitudes of dentists towards this innovative technology. A survey conducted in the UK aimed to assess the status of CAD/CAM technology in dental practices.[13] The findings revealed that most of the surveyed dentists did not utilize any form of digital technology. The high cost and a perceived lack of advantages over traditional methods were identified as primary barriers to the adoption of CAD/CAM technology.

According to the present study, approximately 77% of participants expressed a willingness to adopt CAD/CAM systems in their practices. This figure is notably higher than the 52.2% reported in a 2016 study by Tran D et al.<sup>12</sup>, indicating a growing interest among dentists in advanced technology. The current study also highlighted that 61% of participants identified the high cost of equipment and the need for extended training as significant limitations of CAD/CAM systems. This finding is consistent with Tran D et al.'s study, where 59.3% of participants cited the high cost as a primary barrier to adoption. According to Palanisamy S et al.<sup>13</sup> (2019) only 18.3% are showed that their curriculum contains CAD/CAM system in it. The majority of dentists have agreed that the CAD/CAM technology has affected their decision-making and has resulted in an improvement in the quality of the restoration. These findings are in accordance with Study by Choukse et al. in (2023).<sup>14</sup>

A limitation of the present study is its small sample size. Future research with a larger population could provide more comprehensive insights into the adoption of CAD/CAM technology among dental professionals.

## 6. Conclusion

Following conclusions can be drawn from the study-

1. Most of the practitioners have insufficient clinical knowledge and practice regarding CAD/CAM technology, hence authors recommended to include "Basic Digital Dentistry Learning Module" during Undergraduate level and Advanced Module during Post graduation academic course.
2. The incorporation of digital technologies into routine clinical practice was hindered by the initial high cost of equipment; therefore, assistance for the initial setup could be provided by insurance service providers."
3. Most of the Dental professionals were very optimistic about future of digital dentistry in improving patient care and treatment outcomes but lacks formal training hence educational courses and workshop should be organized.

## 7. Source of Funding

None.

## 8. Conflict of Interest


None.


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